THE PLEISTOCENE GEOLOGY OF THE FOSTORIA QUADRANGLE

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INTRODUCTION

The Fostoria Quadrangle, located in northwestern Ohio, lies within the Central Lowland Province of the Interior Plains Major Division (Fennemann, 1916, p. 39). The middle Maumee beach, which represents the final stage of glacial Lake Maumee, trends nearly east-west across the quadrangle through Fostoria and is the dividing line between the Eastern Lake section on the north and the Till Plain section on the south.

Two distinct types of topography are present in the area. North of the middle Maumee beach a lake plain slopes gently northward, the surface of which is interrupted by several low, nearly parallel beach ridges which trend in a general east-west direction. In addition a few, low, bedrock elevations rise above the level of the lake plain. South of the middle Maumee beach there is an extensive till plain with low swells and shallow basins, becoming more pronounced southward as the crest of the Defiance moraine is approached. This moraine which trends east-west across the southern part of the Fostoria quadrangle, breaks the continuity of the till plain. South of the crest of the moraine the till plain continues across the Carey quadrangle.

The entire quadrangle drains to Lake Erie. The eastern or larger part of the quadrangle is drained by tributaries of the Sandusky River. The part of the quadrangle which lies west of the Seneca-Wood and Seneca-Hancock County lines and north of the Defiance moraine is drained by tributaries of the Portage River. A small area of about 27 square miles in the southwest corner of the quadrangle and south of the Defiance moraine drains westward through The Outlet to the Blanchard River and thence to Lake Erie by way of the Auglaize and Maumee Rivers.

BEDROCK

Although glacial drift of late Wisconsin age blankets most of the surface, bedrock is exposed in a few places. Good exposures are limited to a few quarries. The bedrock of the area consists of two units both of which belong to the Silurian System.

The lower unit exposed, belongs in the upper part of the Niagaran series and is commonly called Guelph. The Guelph crops out over a wide area in west central Ohio over the crest of the Cincinnati Arch. The Guelph is generally a massive, light gray, rough-textured, porous dolomite. It is highly fossiliferous and contains the following forms in abundance: *Pentamerus oblongus*, *Favosites*, several species, *Megalomus canadensis*, *Trimerella ohioensis*, and reef-like structures of Stromatoporoid material. One of these reefs is well exposed in a small, abandoned quarry in the NW¼ of the SW¼ of Section 29, Liberty Township, Seneca County.

The upper unit is the Greenfield member of the Bass Island formation at the base of the Monroe Division. It overlies the Guelph dolomite, is present on the flanks of the Cincinnati Arch and is exposed in the Fostoria quadrangle at the villages of West Millgrove and Bascom. The Greenfield is a cream colored to drab, fine-grained dolomite commonly in beds from two to six inches in thickness with thin, shaly, carbonaceous partings. The Greenfield fauna includes about a dozen species with *Hindella rostralis* and *Leperditia ohioensis* as the dominant forms (Carman, 1927, p. 487).

It is impossible to place accurately the boundary between the Guelph and the

Greenfield units in the Fostoria quadrangle. Most of the area is underlain by Guelph domolite with Greenfield present in the northwest and the southeast parts. On Fig. 1, the boundary is shown by a broken line where it is delimited to a narrow zone and by a dotted line where it is conjectural.

Glacial Features

DEFIANCE MORAINE

This moraine, first called the Leipsic Ridge (Ohio Geol. Reports, 1871) was later named Defiance (Leverett, 1902, p. 581) from the city of Defiance located on this feature. The Defiance moraine, which trends east-west across the southern part of the Fostoria quadrangle (Fig. 1), and whose crest is at an elevation of 850 to 860 feet above sea-level, is composed mainly of boulder clay, but small amounts of gravel and sand are present locally. An outstanding feature of the moraine is its asymmetrical form, as it rises abruptly from the till plain on the south and descends gently northward. The northern slope of the moraine merges gradually into the till plain so that any boundary proposed is purely arbitrary and does not mark a distinct change in topography. There is a gradual decrease in the intensity of the knobs and basins northward but the difference is one of degree and not of kind.

Leighton and Powers, (1934, pp. 86–87) in their work in Illinois pointed out the need for emphasizing the transition between end moraine and ground moraine of the same glaciation where they are composed of the same material. A brief quotation from their paper follows:

> A terminal moraine and the ground moraine of the same glaciation are by definition gradational and not sharply differentiated. . . . In some regions ground and end moraines are reported to differ in composition, but in this area both are composed almost wholly of boulder clay. The boundary which was necessarily drawn in the field, is based only on topography and is intended as a median line between the low subdued swells of the ground moraine and the higher forms of the till ridge. Its gradational character should be indicated on the published map.

White, (1939, p. 283) points out that the inner part of the Broadway moraine, in central Ohio, is not sharply differentiated from the ground moraine but rather merges gradually into it, and in describing the St. Johns Moraine, formed by the same ice lobe, but lying farther south, White wrote:

> Its inner margin is so poorly marked that the exact width is difficult or impossible to determine. (White, 1939, p. 284.)

On the detailed map of this area (Fig. 1) the belt of subdued knobs and basins, which represents a transition between the well developed knob and basin topography and typical till plain is designated *transition zone.*

The ice front remained in the area now occupied by the Defiance moraine for a considerable length of time, but there were minor periods when ablation was dominant and periods when advance was dominant. This resulted in oscillatory movements of the ice front in the area which is now the narrow, restricted, summit portion of the moraine.

As a result of this alternation of advances and retreats of the ice front, drift was plastered beneath the edge of the ice or pushed forward by the advancing ice to a progressively higher position with each readvance. Later, ablation became dominant over supply and the ice front began retreating to the north. Retreat occurred not by a steady recession but by a series of oscillatory movements in which retreat dominated. This resulted in the formation of the transition zone, which varies from three to five miles in width. Following this the ice front retreated steadily northward beyond the quadrangle. The till plain of the northern portion of the area was soon modified by the waters of glacial lakes, but the strip between the transition zone and middle Maumee beach is unmodified till plain.

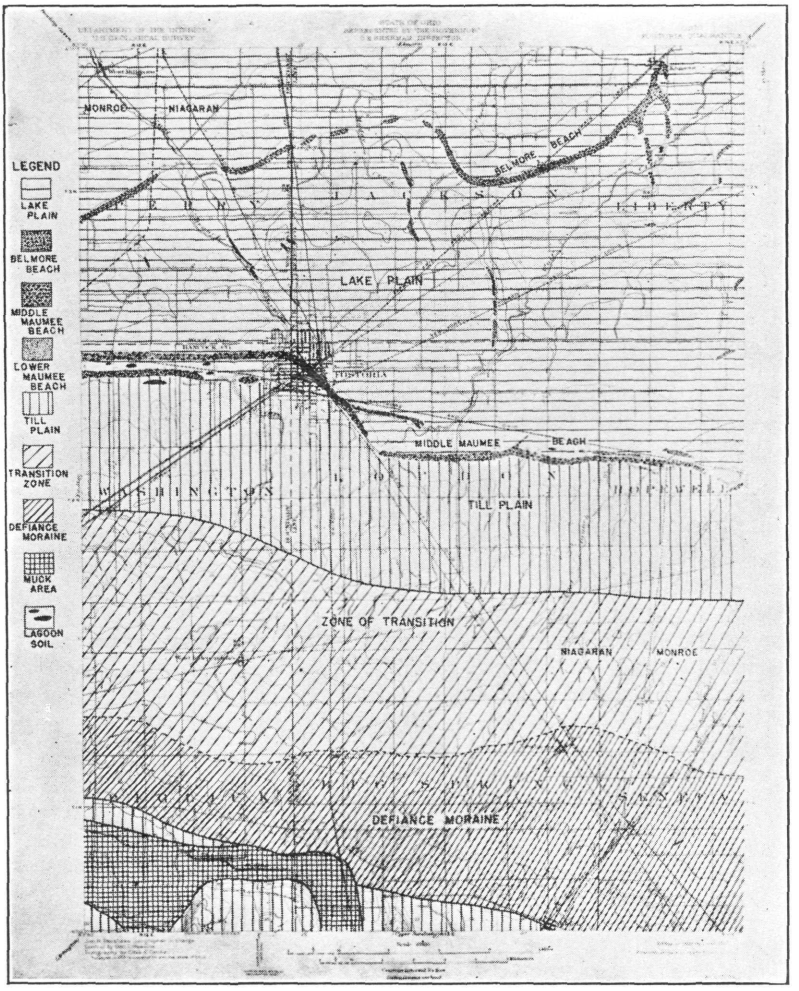

Fig. 1. Glacial map of the Fostoria, Ohio, Quadrangle.

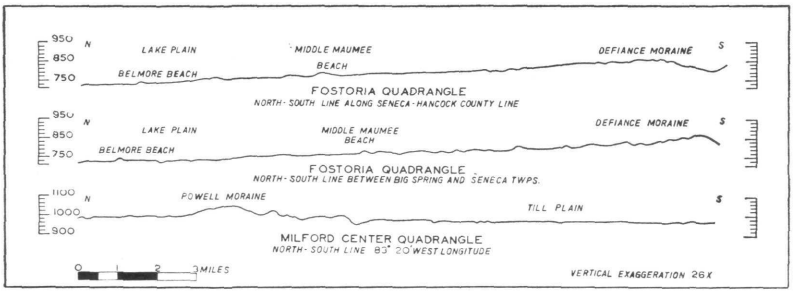

Fig. 2. Three profiles showing the usual asymmetry of terminal moraines in a plains region.

The series of profiles forming Fig. 2 illustrates the usual asymmetry of end moraines in a plains region. The two upper profiles are drawn along north-south lines across the Defiance moraine on the Fostoria quadrangle. The Lake Plain north of the middle Maumee beach gradually slopes northward at the rate of about nine feet per mile. For several miles directly south of the middle Maumee beach the slope of the till plain is also very low. This belt is followed southward by the long, gentle, ice facing slope of the transition zone, which rises southward at the rate of 15 feet per mile toward the crest of the Defiance moraine. The steepness of the outer, southward face of the moraine is accentuated on the topmost profile because of the presence of an old drainage channel at its base. The change from morainic topography to till plain topography is well shown on the middle profile where no modification of the outer slope has occurred.

The lowermost profile is across the Powell moraine on the Milford Center quadrangle. It shows in the northern part a belt of featureless till plain followed southward by the long ice facing slope of the Powell moraine. The outer slope is again very steep and the descent to the till plain is rapid.

These profiles illustrate that in a plains region the ice facing slope of a moraine is a long slope rising gradually to the crest of the moraine and that the outer slope is steeper.

TILL PLAIN

Between the transition zone and the middle Maumee beach there is a strip of till plain several miles in width (Fig. 1). This belt was deposited during a steady retreat of the margin of the continental ice sheet to the north. The slope is eight or nine feet per mile which is less than that of the transition zone. Several other smaller areas of till plain are present near the south boundary of the quadrangle as shown on Fig. 1.

Glacial Lake Features

MUCK AREA

In the southwestern portion of the Fostoria quadrangle in Big Spring and Big Lick townships there is a low, flat area known as "Big Spring Prairie" (Fig. 1). The part within the quadrangle is about six miles long and one to two miles in width. It lies in part just south of the Defiance moraine and extends to the south and the west beyond the quadrangle. The elongated depression in which the prairie lies is down into the rock floor and was a pre-glacial or inter-glacial channel. Tributaries to this channel, now filled with late Wisconsin drift, were described by Bonser (1903, p. 8) in the rock ridge on the south.

A pro-morainal lake of the type described by Hubbard (1915, p. 12) existed in this area from the time of the retreat of the Wisconsin glacier until historic time. When the area was settled the lake basin was gradually drained and is now under cultivation. The history of the lake follows:

Sandy material carried into the lake by the small streams formed deltaic deposits. Fluctuation in the level of the lake exposed at times the sandy material and allowed the wind to pile this material into small dunes. Alternating periods of submergence and emergence resulted in the progressive growth of these dunes. Vegetation encroached upon the lake from the time of its inception and as the plants died and fell to the bottom a considerable accumulation of organic material resulted. Over the dunes the organic material was thin and in the deeper portions of the lake the accumulations were considerably thicker.

A group of dunes was described by Bonser (1903, p. 69) in section 30 of Big Spring township. This sandy condition prevails generally throughout the muck area with patches of dunes at the mouth of each small stream which transported the sand into the lake. Just within the city limits of Carey there are narrow sandy belts in the muck area. Over these sandy belts the muck is only a few inches thick, but becomes progressively thicker in directions transverse to that of the sandy belts. Where sand is absent the muck is underlain with a heavy blue clay.

LAKE PLAIN

North of the middle Maumee beach is a monotonous plain which is a portion of a much more extensive area of lake plain reaching to Lake Erie. The surface is covered with late Wisconsin ground moraine which has been slightly reworked by the waters of the glacial lakes.

Although this portion of the quadrangle is called lake plain there is an absence of any typical lacustrine clays. This has probably resulted from one or both of two conditions: (1) no major streams were bringing material into the lake in this area; or (2) the lake was extremely shallow and any material brought in or worn from the lake floor was carried by the waves and incorporated in the beach ridges or if fine silt was carried out by the undertow and deposited below wave base in deeper water farther north.

GLACIAL LAKE MAUMEE

Lowest Maumee Beach.

Three stages of glacial Lake Maumee are recognized, but only the middle and lowest beaches are present in the Fostoria quadrangle. Throughout northwestern Ohio the lowest beach of Lake Maumee is very poorly developed and fragmentary (Fig. 1) because it was submerged during the formation of the middle beach and was subjected to wave erosion and consequently largely destroyed.

Originally the lowest beach was a well developed and continuous shoreline lying about three miles north of the middle beach, but submergence and subjection to the work of the waves modified the beach until it lost its continuity. The deposits, which now represent the beach, consist of reworked sand and gravel, preserved largely as elongate spits on the landward side of shoal areas, chiefly low rock ridges.

Middle Maumee Beach.

The middle beach of Lake Maumee although about twenty feet higher than the lowest beach was deposited after the formation of the lowest beach when the lower portions of the Imlay outlet were blocked by a readvance of the ice. The beach trends east-west through Fostoria and Bascom at an elevation of 770 to 780 feet above sea-level (Fig. 1). The beach is well developed and is composed of well sorted, cross-bedded, gravel and sand.

This beach enters the quadrangle from the west as a compound beach. The southern or outer beach is poorly developed, but the northern beach is better developed and more complex in structure. Two interpretations may account for the presence of the double ridge: (1) the southern beach may represent a storm ridge built up during periods of high winds; or, (2) the southern ridge may have been the original shoreline and the northern ridge started as an offshore bar in front of it. The presence of highly organic soils between the ridges indicates a lagoon was present, supporting the latter method of development.

GLACIAL LAKE WHITTLESAY

Glacial Lake Whittlesey was named by Taylor (1897, p. 39) in honor of Colonel Charles Whittlesey, one of the early workers on the shorelines of Ohio. Lake Arkona was intermediate in time between Lake Maumee and Lake Whittlesey but it existed at a lower level and is not represented on the Fostoria quadrangle.

The level of Lake Whittlesey was lower than that of any of the stages of Lake Maumee and the outlet was across the thumb region of Michigan. Taylor, 1897, p. 40) originally called the outlet the "Tyre-Ubly outlet" but later used the term "Ubly outlet."

The beach formed by the waters of this lake was called the Belmore beach by Winchell (1873, p. 177) from the village of Belmore, in Putnam County, through which the beach passes.

Belmore Beach.

The Belmore beach, well developed and fairly continuous, trends roughly east-west across the northern part of the quadrangle at an elevation of about 730 feet A. T. (Fig. 1). In the western part, the beach is a ridge of sand and gravel, in places of the dune ridge type. One dune in the SE¼ of the NW¼ of section 21 of Perry township is of the barchan type. The horns of the dune indicate that the prevailing winds were from the northwest.

In the eastern part of the quadrangle near the village of Kansas a well defined, compound, recurved spit is associated with the beach. The spit trends northeast to southwest and the two, long, land-facing termini stand out as elongate, easily visible ridges of sand and gravel. The material is very coarse near Wolf Creek but becomes progressively finer northward.

SUMMARY STATEMENT

The northern portion of the Fostoria quadrangle shows interesting phenomena which are the result of the action of former glacial lakes. Three beaches are present. The southernmost beach is the middle beach of glacial Lake Maumee. The lowest Maumee beach is fragmentary and is represented by elongate spits trending southward from rock knolls. The northernmost beach on the quadrangle is the well developed Belmore beach, the shoreline of glacial Lake Whittlesey. Associated with the Belmore beach just south of the village of Kansas is a well defined, compound recurved spit.

The most prominent feature of the southern half of the quadrangle is the Defiance moraine which trends approximately east-west, passing just south of the village of Alvada. This moraine, whose crest is at an elevation of 850 to 860 feet above sea-level varies from two to five miles in width. An outstanding feature of the moraine is its asymmetrical form, as it rises abruptly from the till plain on the south and descends gently northward. The northern boundary of the moraine is indefinite, and the strong knob and basin topography of the summit portion of the moraine gradually merges into the subdued knobs and basins of the transition zone, which varies from three to five miles in width. North of the transition zone and extending north to the middle Maumee beach is a belt of till plain with a very low slope.

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